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Sizing Post-Cold War Nuclear Forces

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INSTITUTE FOR DEFENSE ANALYSES

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Sizing Post-Cold War Nuclear Forces

I.C. Oelrich

PREFACE

This essay, reporting work supported by the Institute for Defense Analyses as a Central Research Project (CRP), examines some of the factors affecting U.S. choices about nuclear weapons after the Cold War, with a special emphasis on the numbers of weapons that might be required for different ends. The effort and scope of this study were limited. In particular, questions related to homeland missile defenses and how they interact with nuclear forces, especially at very low force levels, are not addressed. This is, of course, a subject that deserves at least as much attention as this effort has been afforded thus far and could be addressed in future work.

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EXECUTIVE SUMMARY

This essay addresses the utility of, and need for, nuclear weapons a decade after the end of the Cold War with a special focus on the numbers and, to a lesser extent, the types of nuclear weapons that are appropriate for particular requirements. The new roles of nuclear weapons have not been thought through and much of our thinking is implicitly carried over from the Cold War. *Specifically, whenever we talk about how far we should “cut” or “reduce” the number of nuclear weapons, we are implicitly accepting Cold War arsenal size as a baseline from which to measure current forces.*

On two counts, the Cold War arsenal is an inappropriate baseline. First, the number of weapons deployed during the Cold War was not the result of a careful quantitative analysis. It was far more arbitrary than we care to acknowledge, making it a questionable baseline even during the Cold War, and making it even more dubious as a starting point for current needs. Second, the justifications for nuclear weapons are now entirely different from those of the Cold War; indeed in many cases our interests concerning nuclear weapons are perfectly reversed. The paper first reviews Cold War justifications of arsenal size and then discusses current justifications for nuclear weapons, again with an emphasis on the numbers required.

The study examines the effects of post-Cold War changes in (1) the stakes involved in international disputes, (2) the conventional balance, (3) the ideological motivations for conflict, (4) war planning, (5) counterforce and countervalue targeting goals, (6) the virtual power imparted by nuclear weapons, and (7) the conventional displacement of nuclear missions.

In every case, forces that pushed us toward large numbers of nuclear weapons have been reduced. Indeed, most incentives have been reversed since the end of the Cold War, pushing the United States toward smaller, not larger, nuclear forces. Stakes are lower than during the Cold War, the conventional balance is much more

favorable, the conflicts with nations are not as likely to be driven by ideology, hence the United States has more limited war aims. Counterforce, always appealing for damage limitation, was essentially hopeless when Russia had thousands of weapons. But it may not be quite so hopeless with much smaller enemy arsenals; so how the requirements for counterforce have changed is complex. The “virtual” power that comes from the mere possession of nuclear weapons is difficult to quantify, but the end of the Cold War almost certainly allows smaller arsenals to adequately support virtual power needs. Finally, progress in precision-guided munitions continues, moving ever more targets from the nuclear column to the conventional column of the ledger.

The study considers four possible uses of nuclear weapons: deterrence of attack by weapons of mass destruction (WMD), damage limitation, tactical war-fighting, and political prestige and virtual power. The required numbers depend on assumptions, of course, primarily about how profligate one can imagine U.S. use of nuclear weapons to be, but the numbers vary from scores for attack against regional enemies to potentially thousands for counterforce against reasonably robust Russian forces.

With most current incentives for the possession of nuclear weapons reversed relative to those obtaining during the Cold War, the United States may wish to reduce its arsenal size and must worry about the consequences of major reductions. The most frequently expressed concern is that steep reductions will entice other nuclear powers, specifically China, to try to compete with the United States by matching its smaller arsenal, whereas had the United States kept a commanding lead, China would never have been tempted to enter the competition. Thus, reductions in U.S. arsenal size could actually increase the number of weapons the United States faces. This paper argues that only a special combination of circumstances will lead to this outcome and, more importantly, the risk associated with such a Chinese response are not irreversible.

A fundamental transformation has occurred. During the Cold War, nuclear weapons were essential to our security because they compensated for perceived conventional vulnerabilities. Now, with clear-cut U.S. conventional superiority, the only threat to the very existence of the United States as a nation and society comes from

nuclear weapons. Thus, the United States has moved from a world in which nuclear weapons primarily enhanced its security to one in which the existence of nuclear weapons primarily threatens its security.

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I. INTRODUCTION

Nuclear weapons are the most powerful instruments in the American arsenal, and this extreme power creates several paradoxes. First and foremost, their enormous destructive capacity makes them the ultimate guarantee of U.S. national sovereignty; yet that same capacity makes nuclear weapons the only thing in the hands of potential enemies that can threaten the very survival of the United States as a nation and society.

This essay addresses the need for nuclear weapons a decade after the end of the Cold War with a special focus on the *numbers* required. The new roles of nuclear weapons have not been thought through, and much of our thinking is implicitly carried over from the Cold War. *Specifically, whenever we talk about how far we should “cut” or “reduce” the number of nuclear weapons, we are implicitly accepting Cold War arsenal size as a baseline from which to measure current forces.*

I argue below that, on two counts, the Cold War arsenal is an inappropriate baseline. First, the number of weapons deployed during the Cold War was not the result of a careful quantitative analysis. It was far more arbitrary than we care to acknowledge, making it a questionable baseline even during the Cold War, and making it even more dubious as a point of departure for current needs. Nevertheless, our nuclear history has persistent effects on current thinking, so this essay, while directed toward *future* requirements for nuclear forces, devotes considerable space to review of the Cold War justification for nuclear arsenal size. Second, the justifications for nuclear weapons are now entirely different from those of the Cold War. Indeed in many cases the questions we must ask ourselves are similar to those appropriate during the Cold War but the answers are perfectly reversed.

Are the numbers of nuclear weapons held by the United States, or any other country, important? Clearly the urgency surrounding nuclear weapons is much less than it was during the Cold War. It may be true that, with the end of the Cold War, the size of our current nuclear arsenal is as inappropriate now as the size of our World War II conventional forces were after that war ended. But in 1946 there were powerful political and economic pressures for rapid demobilization. Nothing comparable is forcing

reevaluation of post-Cold War nuclear forces. One approach would be to leave well enough alone. No obvious, immediate disaster lies along that path. I argue here that there is some risk associated with maintaining the status quo. The more important motivation for change, however, is the opportunity cost of doing nothing. Nuclear weapons in the hands of potential enemies are the only things that threaten the very existence of the Nation. If we can find reversible, low risk actions that might reduce that fundamental threat, then it would be tragic not to try.

One particular spur for this essay was the paper “Rationale and Requirements for U.S. Nuclear Forces and Arms Control,” authored by Keith Payne who summarized the views of a distinguished panel of national security analysts.¹ Payne rightfully criticizes advocates of deep reductions for not justifying whatever number they pick. Suspiciously round numbers, such as the National Academy’s recommendation that the United States and Russia go to “about 1000” warheads,² suggest lack of quantitative support. One white paper circulated during the transition of administrations stated that 1500 warheads “should be about right.” Payne states that “Recommendations concerning the size and composition of U.S. nuclear forces must be informed by the broad requirements of U.S. foreign policy and strategy, including possible deterrence and wartime goals.”³ Yet, while chastising those who argue for deep reductions without justifying specific numbers, Payne’s report avoids this pitfall by providing no numbers at all, except to make clear that others’ recommendations have been too low. As Payne goes on to state, “It is not useful to make proposals concerning the proper size and composition of the U.S. nuclear arsenal without prior, careful examination of U.S. foreign policy goals and the extent to which nuclear weapons may be necessary to support those goals, now and in the future.”

Payne further writes that

The challenge of linking the U.S. nuclear force posture to current and potential requirements is demanding. Such a study, to have integrity, must take into account a significant number and variety of complex, dynamic factors. To address them adequately, in an effort to link strategy to force

¹ Keith Payne, “Rationale and Requirements for U.S. Nuclear Forces and Arms Control,” *Vol. 1, Executive Report*, National Institute for Public Policy (NIPP), January 2001. (This paper is available on the NIPP web site: www.nipp.org.)

² *The Future of U.S. Nuclear Weapons Policy*, Committee on International Security and Arms Control, National Academy of Sciences (Washington: National Academy of Science, 1997), p. 7.

³ Payne, p. 3.

structure, requires access to some closely-held, classified, and specialized information, and the support of trained military professionals.⁴

This current essay certainly is not the exhaustive, definitive study that is needed to define precisely U.S. nuclear force requirements, but it does make an attempt to apply numbers to warhead requirements. I explicitly reject the implication that secrecy and “specialized information” make it impossible for civilian leadership, specifically the Congress, or even the interested public, to understand the need for nuclear weapons and, hence, assess the required numbers.

Several questions must be addressed when deriving quantitative warhead requirements: What are nuclear weapons for? If they are to deter, who, what, and how are they to deter? If they are intended to provide political leverage of some sort, what is the mechanism by which that leverage is provided, and how does it depend on the absolute and relative number of weapons? If they are to be used for warfighting, what types of targets are they meant to destroy? And how many?

Although our thinking about current forces should not be cast in terms of “reductions” from a Cold War baseline, in terms of actual equipment and weapons that perspective is unavoidable. Given the much-reduced emphasis on nuclear weapons and given other more pressing military needs, there is little likelihood of major new nuclear weapon systems soon. There will be additions and upgrades, but we are also going to have to work with the hardware that we have on hand, reducing and scaling down as appropriate. Thus, tomorrow’s nuclear forces will most likely be made up of some smaller, perhaps modified, version of Cold War forces. Nevertheless, the paper ends with some speculation on what new weapons might be desirable.

Finally, this essay does not address at all the effects of national missile defenses on warhead needs and the incentives they would create for potential adversaries. Given the limited resources available, it seemed better to put consideration of defenses aside entirely until they could be handled properly.

⁴ Payne, p. 4

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II. HOW WE GOT TO WHERE WE ARE: A QUICK REVIEW OF THE COLD WAR NUCLEAR FORCES

The following is, no doubt, a very familiar story to most readers, but a quick review of the course of the Cold War, with particular attention to decisions about nuclear arsenal *size*, will lend perspective to today's debate about force level decisions. Using Cold War thinking and planning as a baseline is understandable. An enormous amount of thought went into nuclear strategy during the Cold War, intellectual capital that is not abandoned lightly. Few Cold War thinkers are, however, ready to claim that they understand with any confidence exactly how deterrence worked or why (or even whether it worked; if neither side ever really seriously considered war, then we can't really say they were dissuaded from it). We can just observe that, in fact, no war broke out. During a period that most people considered nerve-wrackingly dangerous, we did not have a war between the superpowers and, in particular, we did not unleash a nuclear war that could have resulted in more human loss, potentially an order of magnitude more, than any previous war. Given these results, and given that our understanding of how we brought them about is short of unequivocal, it is natural that the United States and Russia would approach any radical changes in their nuclear arsenal cautiously. We are like travelers who find themselves caught in an unknown forest as night falls. We feel secure staying close to the campfire, and the firelight allows us to see clearly what is nearby. When we venture away from the fire, we risk unknown dangers. But staying close to the fire will never get us out of the forest.

Immediately after WWII, the U.S. military thought of nuclear weapons simply as more efficient tools for strategic bombing,¹ in a straightforward extrapolation of WWII thinking. Inter-war air power advocates had argued that massive air attacks against cities, with the objective of destroying morale, would decide any political or military issue before a ground war could even get started. WWII experience did not, of course, bear this out even though the United States put enormous resources toward strategic bombing.

¹ The single best volume on the history of the development of Cold War strategy is Lawrence Freedman, *The Evolution of Nuclear Strategy* (New York: St. Martin's Press, 1981).

Despite this failure in practice, the theory did not have to be abandoned because it was saved by technical developments: nuclear bombs made possible the devastation that was only hoped for before the Second World War.

With the close of WWII, relations between the West and its WWII Soviet ally quickly collapsed. Within just 2 years, hostility with the Soviets was undeniable, and the world appeared to be settling in for a long-term confrontation. Western demobilization was not matched by the Communists, and there was little political support in the United States or Western Europe for military spending. To compensate for these conventional vulnerabilities (often expressed as the “imbalance in manpower”), the United States explicitly planned to exploit its nuclear monopoly.

John Foster Dulles wrote that the United States should use the threat of “massive retaliation” to deter attacks by the communists.² In his 1954 Foreign Affairs article, he said, “The heart of the problem is how to deter attack. This, we believe, requires that a potential aggressor be left in no doubt that he would be certain to suffer damage *outweighing any possible gains from aggression.*” (Emphasis added.) That is, the level of destruction that was required and, in consequence, the size of the nuclear arsenal, had to be matched to the *stakes* that were in play.

During the Cold War, the Western world viewed the stakes as very high indeed. The front lines of the Cold War cut through Europe. NATO perceived itself vulnerable to conventional attack. If the Soviets could overrun Western Europe and place its population and productive capacity on the Communist side of the global balance, then the United States and the rest of the world might not be able to long resist the increased military pressure. A worldwide Communist domination could follow, from which freedom might not reemerge for generations.

As long as the United States had a nuclear monopoly, it could plausibly threaten to bomb cities as punishment for an attack by the Soviets. Even with Europe as the prize, the number of Soviet cities that needed to be threatened to effect deterrence was presumably fairly small, perhaps scores. Certainly loss of the largest 100-200 Soviet cities would be a great enough loss to make capture of Europe seem unattractive. The

² John Foster Dulles, credited with the term “massive retaliation,” used it in speeches and interviews from 1950 but is most often cited through his article, “Policy for Security and Peace,” *Foreign Affairs*, 32(3), 1954.

required number of nuclear weapons was roughly equivalent to the number of targets, that is, scores or perhaps a couple of hundred.

Everyone knew that the U.S. nuclear monopoly would end eventually. (And, in fact, the Soviets' 1949 bomb test was much earlier than the West had expected.) The Soviet atomic bomb threatened to negate the U.S. nuclear deterrent, which the United States was depending on to counter a conventional threat. The United States could still threaten the Soviets with nuclear attack if they tried to grab Western Europe but the Soviets could threaten to retaliate against the U.S. homeland with attacks of their own. Thus, nuclear deterrence seemed checkmated, and Europe once again appeared vulnerable.

Two very different responses were proposed to the Soviet's development of their atomic bomb and the expected buildup of an atomic arsenal. One response was to up the ante and maintain the same *relative* nuclear advantage despite Soviet atomic bombs. That is, the United States could develop thermonuclear weapons, or the "Super." The Soviets might be able to counter U.S. atomic deterrence with atomic bombs but if the United States could do *substantially* more damage, then perhaps deterrence would be preserved. Specifically, the Soviets might use atomic weapons to inflict serious damage on the United States, but if the United States could threaten to inflict far more using thermonuclear weapons, then, even with the prize of Europe thrown in, it would seem to the Soviets to be a bad trade. Even with higher damage requirements, as long as cities were the main targets, the number of weapons required was not large—as with atomic bombs, probably in the scores, perhaps a couple of hundred.

The other response was to build smaller, not larger, weapons. For example, J. Robert Oppenheimer and others in the General Advisory Committee Report to the Atomic Energy Commission argued that, if the problem was the vulnerability of Europe, then the United States should solve that problem directly by making small tactical nuclear weapons that could be used to stop a Soviet invasion of Europe, not indirectly by threatening to destroy their cities.³ Considering nuclear explosives as battlefield weapons had the potential to expand enormously the *numbers* required. If a small artillery-fired

³ This was the beginning of the nuclear version of the debate about deterrence through retaliation versus deterrence through denial. See Jack Snyder, *Deterrence and Defense*, (Princeton: Princeton University Press, 1961).

warhead might be used against a formation of 10 tanks and the Warsaw Pact had tens of thousands of tanks, then thousands of small nuclear warheads might be needed.

Once nuclear explosives were considered for battlefield use, other applications present themselves, from demolition charges to depth charges, to use against supply lines in the enemy's tactical rear and, consequently, the number of warheads grows far beyond the needs of simple retaliatory deterrence. Admiral Stansfield Turner relates how he began to question nuclear targeting plans when, as a Rear Admiral and Eastern Mediterranean Task Force commander, he was reviewing his task force's nuclear attack plans and the first target to come up was a Bulgarian railroad bridge that was too small to show up on the reconnaissance photograph but targeted with a multi-kiloton weapon.⁴

In the end, the United States pursued both approaches and its arsenal grew but, by the Kennedy administration, the Soviets had nuclear forces large enough that the United States had to worry about deterring Soviet nuclear attacks as well as their conventional forces. The United States had developed a substantial deterrent force but there was, by general consent, a shortage of logical justification for the precise size of the nuclear arsenal at that point and Secretary McNamara set out to quantify requirements.

McNamara spoke of several levels of destruction but eventually settled on sizing forces to meet the requirement to destroy 20-25 percent of Soviet population and half its industrial capacity after the United States had absorbed a first strike. One reason these numbers were chosen is that they are at the "knee" of the damage versus warhead curve. Thus, the United States set its target objective in part by what was required and in part by what was achievable. A table presented by Enthoven and Smith⁵ shows that 400 equivalent megatons were estimated to destroy 76 percent of Soviet industrial capacity, while 800 equivalent megatons would destroy 77 percent with no further increase when doubled again to 1600. They concluded,

Thus, the main reason for stopping at 1,000 Minuteman, 41 Polaris submarines, and some 500 strategic bombers is that having more would not be worth the additional cost. These force levels are sufficiently high to put the United States on the 'flat part of the curve'—that is, at a point

⁴ Stansfield Turner, *Caging the Nuclear Genie: An American Challenge for Global Security* (Boulder: Westview Press, 1997), p. 8.

⁵ Alain C. Enthoven and K. Wayne Smith, *How Much Is Enough?: Shaping the Defense Program, 1961-1969* (New York: Harper & Row, 1971), Table 11, p. 207.

where small increases in target destruction capability would require enormous increases in forces, and therefore in cost.⁶

Once presented as an “adequate” deterrent, very few people argued. While the level of threatened destruction needed to deter the Soviets was, of course, unknown, almost everyone agreed that, whatever that level was, the McNamara goals were higher than the required minimum. Deterrence is not something one can have too much of, so there seemed to be no disadvantage to having too many nuclear weapons, aside from the cost. Not knowing where the “right” number for deterrence lies, a rational strategy was to build until everyone was certain that the right number, wherever it lay, had been passed. The danger with this approach is that we become so accustomed to this arbitrary number that we begin to believe that anything less than clearly adequate appears inadequate when, in fact, we are almost certainly resting on a broad, flat part of the deterrence curve.

As the Cold War progressed and superpower arsenals matured, a situation of reciprocal vulnerability seemed to achieve mutual nuclear deterrence and some measure of stability. This situation was unacceptable to many strategists for several reasons. The primary objection was cast as moral. Donald Brennan took the widely used term “assured destruction,” added “mutual” to the front, and created an acronym, MAD, that provided its own commentary on the global strategic situation.⁷ Some argued that, if war could be resolved by attacking just forces and industry, then lives could be spared. Arguing for the abandonment of MAD, Fred Ikle wrote,

A good place to begin is to cast out the dogma that to deter nuclear attack, the threatened response must be the mass killing of people. By taking advantage of modern technology, we should be able to escape the evil dilemma that the strategic forces on both sides must either be designed to kill people or else jeopardize the opponent’s confidence in his deterrent. The potential accuracy of ‘smart’ bombs and missiles and current choices in weapon effects could enable both sides to avoid the killing of vast millions and yet to inflict assured destruction on military, industrial and

⁶ Enthoven, p. 208

⁷ Wolfgang K. H. Panofsky, “The Mutual Hostage Relationship Between America and Russia,” *Foreign Affairs*, 52(1), pp. 109-118, October 1973. Stephen Van Evera amusingly demonstrates how acronyms can be created to good editorial effect. His nuclear worlds include PAST (Pre-Atomic State), BAD (Both Are Defended), WORSE (Winning Only Requires Striking Early), and USA (Unilateral Superiority, American). Stephen Van Evera, *Causes of War: Power and the Roots of Conflict* (Ithaca: Cornell University Press, 1999), p. 242.

transportation assets—the sinews and muscles of the regime initiating war.⁸

This strategy, in the extreme, has an effect equivalent to that of introducing tactical nuclear weapons to the battlefield; that is, it greatly expands the number and types of targets, hence greatly increasing the number of required weapons. Where before one large bomb might be directed toward a city, now many bombs must be directed to specific targets: power plants, refineries, barracks, and so forth.⁹

An additional motivation for at least trying to avoid direct attack on cities was that threats of attacks against an enemy's cities cannot credibly deter any enemy attack short of his attack against cities. That is, if nuclear weapons are useful only for the ultimate deterrent and that is incredible except against the ultimate attack, then nuclear weapons cannot deter lesser adventurism. This dilemma became increasingly uncomfortable because the United States had defense obligations in Europe. All-out retaliation in response to attacks there might not have been viewed as credible. This problem of deterring aggression in Europe, plus the moral problems with an anti-city retaliatory strategy, pushed the United States in the late 1970s toward a “countervailing” strategy.¹⁰

The countervailing strategy envisioned countering the Soviets at every possible level of violence. The United States would meet a conventional attack with a conventional defense, tactical nuclear weapons with tactical counterattacks, and homeland attacks with retaliation against the enemy homeland. Key to the strategy, however, was the ability to threaten counterforce attacks on Soviet central strategic systems. This requirement was a consequence of “extended deterrence,” that is, extending U.S. central nuclear deterrence to NATO allies. It required some plausible

⁸ Fred Charles Ikle, “Can Nuclear Deterrence Last Out the Century?” *Foreign Affairs*, 51(2), pp. 267-285, January 1973.

⁹ Because industry and transport and communications nodes tend to be co-located with population, and nuclear fire and fallout effects tend to be neglected, it is not clear that this approach would, in practice, avoid, or even reduce, civilian deaths. In any case, the approach, regardless of its feasibility, would require more weapons.

¹⁰ The United States had long targeted Soviet military assets, including nuclear weapons, so the strategy did not appear suddenly. Moreover, the changes in language were greater than the changes in actual targeting doctrine. The term “countervailing strategy” was adopted officially during the Carter administration and continued into Reagan's. For an extremely critical but useful description of the strategy, see Robert Jervis, *The Illogic of American Nuclear Strategy* (Ithaca: Cornell University Press, 1984), especially Chapter 3, “The Countervailing Strategy and Its Areas of Incoherence.” The titles set the tone.

threat to strike first in response to conventional aggression, which required, in turn, some plausible advantage to striking first. It had to be a war-fighting strategy. Civilian strategists had warned of the dangers of instability if either side developed disarming first-strike capabilities, but the demand for a war-fighting capability overrode such concerns. As a result, most strategic weapons, including bombers, sea-launched ballistic missiles (SLBMs) and intercontinental ballistic missiles (ICBMs), were upgraded to allow attack on hard point targets, specifically Soviet ICBM silos. This “conventionalization” of intercontinental nuclear war further increases the number of weapons that are needed. As the Cold War went on, both sides eventually deployed arsenals of tens of thousands of warheads from tactical to intercontinental range.

Why did both sides need so much? There are several reasons. Foremost was, I believe, the ideological nature of the contest. The Soviet Union had, or the West believed it had, an ideological imperative toward world domination and a totalitarian political structure that was anathema to, and utterly irreconcilable with, Western values. Soviet propaganda made it clear that they felt the same way toward the liberal capitalist democracies. Both sides saw themselves as competing for control of the world’s history and future. If the whole world is the prize, then the damage that must be inflicted to “outweigh any possible gains from aggression” must be very high indeed. The potential prize of winning everything had to be balanced by the potential risk of losing everything.

The ideological nature of the competition also affected the nature of the damage that needed to be inflicted. This was not like historical European great power rivalries. In an ideological contest, the enemy is the opponent’s ideas, and ideas can be expected to survive a war, even a nuclear one. The nuclear war would be just the first shot in what was foreseen as a long-term struggle for survival of ideologies. The United States was primed for the Cold War by WWII, a total war fought for unconditional surrender in which strategic bombing played a major role. Once the Soviets acquired intercontinental nuclear weapons, however, the United States recognized that even if it “won” a war against the Soviet Union, it would be so debilitated, and the Soviet Union was so vast, that a post-WWII-style military occupation of a defeated enemy nation would be impossible. Without a follow-up occupation, the ideological enemy was expected to resume the contest as soon as it was able.

Thus, one objective of nuclear war planning was to increase to the greatest extent possible the enemy’s economic recovery time. A nuclear war would knock both sides

down flat. Whoever got to his feet first won. As Secretary Rumsfeld put it in his 1978 Report to Congress,

We believe that a substantial number of military forces and critical industries in the Soviet Union should be directly targeted, and that an important objective of the assured retaliation mission should be to retard significantly the ability of the USSR to recover from a nuclear exchange and regain the status of a 20th-century military and industrial power more rapidly than the United States.¹¹

This war aim required more than hitting a few key nodes to temporarily knock out military capabilities. It required very deep targeting of the entire industrial infrastructure, with a resultant large number of required nuclear weapons. Desmond Ball claims that, at one point, the National Strategic Target Data Base contained 50,000 distinct potential targets for Single Integrated Operations Plan (SIOP)-6.¹²

The critical role of nuclear deterrence in American strategy also increased the number of required weapons. Deterrence of nuclear attack was the fundamental, indispensable foundation of the Nation's security. As a result, calculations of weapon requirements were extremely conservative, allowing for large margins of error. For example, because blast is predictable, while thermal and fallout effects are weather-dependent, blast was often the sole basis for damage calculations.¹³ This is appropriate for direct effects on some targets, for example missile silos. But it is a very conservative approach to calculating weapon effects on above-ground targets, whether military bases, industry, or cities.

The nuclear triad was, in part, a product of this conservative design philosophy toward nuclear forces. The attributes of each leg of the triad were meant to be mutually supporting, to create a total arsenal that was more survivable than any one of its

¹¹ Donald Rumsfeld, *Report of Secretary of Defense Donald H. Rumsfeld to the Congress on the FY 1978 Budget, FY 1979 Authorization Request and FY 1978-1982 Defense Programs* (Washington, DC: U.S. Government Printing Office, 17 January 1977), p. 68.

¹² Desmond Ball, "The Development of the SIOP, 1960-1983," *Strategic Nuclear Targeting*, Desmond Ball and Jeffrey Richelson, eds. (Ithaca: Cornell University Press, 1986), p. 83.

¹³ Lynn Eden, Center for International Security and Arms Control, Stanford University, personal communication. Dr. Eden's ongoing work investigates how damage calculations, specifically the neglect of fire and radiation, affect targeting requirements. Apparently some effort has been devoted to using fallout to create no-go zones where workers would be unable to get to industrial areas, but as a "bonus" not as a way of reducing warhead requirements. See William M. Arkin, "Bring on the Radiation," *Bulletin of Atomic Scientists*, Vol. 53, No. 1, Jan/Feb 1997, pp. 72.

components would be alone. ICBMs or bombers alone might be vulnerable, but attacking the two together poses a puzzle of conflicting requirements that cannot be solved. The attacker picks the leg to attack and the United States retaliates with what is left, so each leg alone must alone contain forces sufficient to assure deterrence by being able to inflict unacceptable damage. Thus, the three legs of the triad produced a total force roughly three times the retaliatory force required to destroy the Soviet Union.

It was important not just to be able to respond to various challenges, but to be seen as being able to respond. As Harold Brown wrote,

...behavior in periods of tension can be (and in my judgment is) influenced by the nature of the strategic capabilities and the relative balance of strategic forces, even if the use of those strategic forces is very unlikely. Real consequences have followed the shift since the late 1960s away from a perceived U.S. strategic superiority. This U.S. advantage would have been of only marginal value in a thermonuclear war and was of limited political value, but its loss has had a significant effect on relations between the United States and its allies and on the attitudes of people in other countries toward the United States.¹⁴

Thus, beyond any military requirements, the United States should have the appearance of superiority. Clearly, if both sides have similar views, there is no stable end state, and the arguments for additional weapons can continue to grow wholly independent of any military need. The utility of the *appearance* of strategic parity was one justification for the buildup of strategic forces during the Reagan administration. Some argue that it was the buildup of latent military power, including strategic nuclear systems, that, indeed, brought down the Soviet Union, ending the Cold War.

¹⁴ Harold Brown, *Thinking about National Security: Defense and Foreign Policy in a Dangerous World* (Boulder: Westview Press, 1983), p. 51.

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III. AFTER THE COLD WAR: WHAT IS DIFFERENT TODAY.

Now that the Cold War is over, almost everything has changed. Indeed, many incentives regarding nuclear weapons are perfectly reversed. The Cold War vulnerabilities to conventional attack in Europe have disappeared while some new ones have arisen, the stakes are lower, ideology is much reduced as a factor resulting in much reduced war aims. Perhaps ironically, as force levels go down, counterforce becomes more attractive. Finally, the virtual power conferred by the mere existence of nuclear weapons, always difficult to specify, has changed but how is just as difficult to pin down.

A. THE CONVENTIONAL BALANCE

The most profound change affecting nuclear calculations is often overlooked because it concerns the nuclear balance indirectly: The purpose of nuclear weapons was, of course, to deter the use of nuclear weapons, but also as the final backstop against conventional aggression and U.S. vulnerability to a conventional threat in Europe has disappeared. Removing the enormous threat to Europe has freed up resources that have enhanced relative U.S. power around the world. In most regions of the world in which it has an interest, the United States is in a strong position militarily. The combination of conditions that obtained during the Cold War, being vulnerable to conventional attack at a point that is vital to U.S. long-term survival, is not now foreseeable. If, during the Cold War, nuclear weapons had disappeared, the United States would have been vulnerable to attack in Europe. If all nuclear weapons magically disappeared today, the relative security of the United States would improve immensely.

B. LOWER STAKES

Dulles's Cold War formula was that an aggressor should "suffer damage outweighing any possible gains from aggression." During the Cold War, the potential "gains" were Europe and perhaps the world. What is the equivalent today? The ambitions of the world's expansionist or revanchist states that affect U.S. interests are

quite modest when compared to possible Soviet designs on Europe.¹ Wherever discussions of nuclear confrontation begin, they most often end up focused on the China-Taiwan dispute because that is the one significant unresolved territorial question between the United States and another nuclear-armed power.² Loss of Taiwan would be a political and human rights disaster. One can imagine, however, sometime in the future a negotiated, mutually agreed, voluntary Hong Kong-like resolution of the Taiwan dispute that would move the population and economic and military power of Taiwan from the U.S. friendly side of the balance and place it in the Chinese side. Such a shift, while unwelcome, would not upset the overall balance of global power. Change in the status of Taiwan is not comparable to change in the status of Europe.

We must make a special effort to keep focus on the stakes involved when evaluating the deterrence of Russia. Fresh thinking about Russia is often deflected by the long Cold War history with the Soviet Union. Unlike the Soviets, the Russians present no obvious territorial ambitions. They seem intent on maintaining some special security relationships with parts of the former Soviet Union and have used economic leverage to extract concessions, sometimes blatantly, for example, by threatening Georgia with a cutoff of natural gas. But the Russians seem to have their hands full in Chechnya, and no one there is planning an invasion of Germany. Nevertheless, sometime in the future the Russians could be tempted to intervene militarily elsewhere along their border in areas where the United States might have extended security guarantees, for example, in support of the Russian minorities in any of the Baltic countries, even after the United States had made some security arrangement there. Yet such severely scaled-back ambitions can be countered with severely scaled-back threats of retaliation. The United States had to threaten substantial pain to be confident that the Soviets would see snatching Europe as a bad deal. Presumably, significantly less pain must be threatened to make snatching Latvia seem to be a bad deal. (This assumes, of course, that the Russians could muster the conventional forces needed to successfully invade Latvia.) The profoundly lower ambitions that must be deterred translate into significantly lower numbers of nuclear weapons required for deterrence.

¹ While working on this project, attacks on the United States demonstrated that some non-state terrorists might have huge ambitions: the destruction of all of Western civilization and culture. But nuclear forces did not and will not deter those sorts of attacks.

² Kashmir is another area of confrontation between nuclear powers but includes the United States less directly.

C. IDEOLOGY

The ideological motivations for great power international rivalry are much diminished and that too diminishes the needed numbers of nuclear weapons. The reduced need is partly because ideology affects the size of the stakes involved. If Communist governments are pursuing an ideology that includes world domination, then the greatest potential stakes are everything and the greatest potential deterrent must be huge. Non-ideological contests tend to be about more immediate interests and conflicts. A nuclear attack on the Soviet Union was intended to destroy it as a society and make it as difficult as possible to ever recover. In contrast, during the Persian Gulf War, the United States and its allies had no fight with the Iraqi people, had very limited aims regarding the Iraqi government, and had no interest in destroying Iraq as a nation or society. One result was, for example, that some effort was made to bring down the electric power grid by attacking electric substations rather than power plants, specifically to make post-war recovery easier. In future conflicts, response to specific actions will be to threaten to apply force until those actions stop (and, we hope, to deter the actions in the first place). Future conflicts will not require the nuclear equivalent of tilling salt into the soil. Thus, the targeting of future enemies will be neither as deep nor redundant and complete as targeting of the ideological Soviet enemy was. “Shallow” nuclear targeting of infrastructure clearly requires fewer weapons than deep targeting.

The more limited aims of foreseeable, non-ideological wars create different priorities for targets and remove some targets altogether. Specifically, when the destruction of Soviet communism was a war goal, destroying all mechanisms for political and military control made sense. This included political leadership such as regional capitals, alternative leadership regrouping points, and an extensive communications system. Future conflict with Russia would be for more limited stakes. Presumably the United States no longer has any war objective that includes destroying Russia and its people as a nation and society. Thus, the immediate goal of a future nuclear war with Russia will be to stop the war as quickly as possible, suggesting that maintaining communication with the leadership would be valuable to the United States. To the extent that the United States decides to forego the targeting of Russian leadership, the number of nuclear weapons needed for that mission is also reduced.

D. WAR PLANNING

Strategic objectives determine the number of targets and the degree of redundancy required. After a war, steel mills and concrete plants can be used to make more steel mills and concrete plants. But with nothing at all to start with, that boot-strapping becomes impossible. When trying to destroy a modern industrial society, there is, therefore, a large incentive to try for total destruction of key sectors of industry. This involves multiple warheads per target and targeting of even relatively minor facilities, both of which drive up warhead numbers. If the future goal of nuclear attack is to apply pain until some action stops, then the number of targets that needs to be hit goes down but also the redundancy of targeting is reduced. For example, if the United States wants to destroy 50 percent of Russian electrical generating capacity but doesn't really care which 50 percent, then the United States doesn't really care if a few targets are missed because of delivery failures. Thus, redundant targeting, that is, shooting several warheads at each aimpoint, can be avoided.

Targeting redundancy also resulted simply from the overall conservatism with which nuclear planning has been approached. In a 1958 memorandum to then Secretary of State Dulles, Gerard Smith reported that the Strategic Air Command's planned attack on Moscow totaled 100 megatons. He wrote, "I was advised that the study assumed that Moscow would be hit by IRBMs [Intermediate Range Ballistic Missiles], fleet ballistic missiles, air-to-surface missiles, and ICBMs before being hit by SAC airplane delivered bombs."³ Thirty years later, the attack was just as intense, with almost 500 warheads targeted on Moscow and the surrounding area and 69 warheads targeted on a single anti-missile radar.⁴

Any system that is truly critical to our personal survival (for example, the controls on an airplane) will be designed with obsessive attention to reliability and with multiple backups. When nuclear deterrence was perhaps the central aspect of the superpower conflict, the same hyper-conservative, redundant attitude toward targeting might have been inevitable. Today, nuclear deterrence is still important, but it is not central. Under these circumstances, planning can be more realistic, with an eye toward most likely

³ "Memorandum for the Secretary, Oral Presentation of the Annual Report of the Net Evaluation Subcommittee," Gerard Smith, 25 November 1958.

⁴ John Berry and Evan Thomas, "Dropping the Bomb," *Newsweek*, 25 June 2001, p. 28.

outcomes, rather than worst case outcomes. One hundred megatons on Moscow was never needed, it was just the result of this very cautious redundant targeting philosophy that is no longer appropriate. War aims less than the assured, utter, irreversible annihilation of the Soviet Union can be met with much smaller attacks.

E. COUNTERFORCE AND COUNTERVALUE

How counterforce and countervalue incentives have changed with the end of the Cold War are difficult to characterize. In the absence of effective defenses or radical arms control, aggressive counterforce is the only hope for escaping the condition of mutual assured destruction or MAD. It is important to keep in mind that, regardless of how some chose to characterize it, MAD was never a “strategy” or “doctrine.” MAD was a state of affairs during the Cold War. Few ever advocated a MAD strategy as a desirable goal. The debate between most “supporters” of MAD and its opponents has been between those who, on the one hand, recognized it as the state of affairs and believed it to be undesirable but inevitable and inescapable and those, on the other hand, who recognized it as the state of affairs but did not accept it as inevitable.

Most of those who might have been described as supporting a MAD doctrine believed it to be the least bad of many awful alternatives and that anything either side did to escape the inescapable would only make matters worse than they already were. In particular, they argued that attempts to escape mutual vulnerability by developing counterforce capabilities would inevitably fail because enough enemy weapons would always survive to destroy the attacker, but such attempts would make both sides nervous and create first-strike incentives and, as the other side responded to the counterforce threat, arms race instabilities as well. Thus, “supporters” argued that attempts to escape MAD were not only hopeless but that they created a world where war was more likely and would be more horrific if it occurs.

During the Cold War, debate about whether to live with MAD or to escape it was largely theoretical. With tens of thousands of warheads available, the level of destruction resulting from a nuclear war was going to be beyond human experience no matter how effective counterforce attacks were.

Today two things are changing. First, force levels are going down and, second, Russian strategic nuclear forces are vulnerable when at low alert levels, and they are typically at low alert levels. Russian practice in mobile ICBM and SSBN (nuclear-

powered ballistic missile submarine) deployment plus large, easily identified gaps in Russian warning coverage create lucrative targets for a U.S. first strike. If force levels continue to be reduced simply by scaling down Cold War arsenals, then there will come a point where counterforce first strikes by the United States would be able to make meaningful differences in the damage inflicted on the United States by Russian retaliation. The condition of American and Russian forces are already at the point where bolt-out-of-the-blue attacks by the United States on Russia could be very effective at limiting return damage. Thus, what was hopeless before may not be in the future. When deciding on future force sizes, the United States must make real, not hypothetical, decisions about whether it wishes to develop a capability for a disarming first strike against Russia or other emerging nuclear powers such as China.

F. VIRTUAL POWER

The value of nuclear weapons as symbols of political power is perhaps the variable that is most difficult either to support or dispute and almost certainly impossible to quantify. James Schlesinger has argued that nuclear weapons provided the United States an assurance of strength and security as the Cold War unfolded, an assurance that allowed the United States to remain forcefully engaged on the world stage. Indeed, he judges this assurance from nuclear weapons to be as important as the deterrence they provided.⁵ Harold Brown, quoted earlier, said that the loss of the *appearance* of nuclear advantage, even if unimportant in any militarily meaningful sense, damaged U.S. power and prestige. That nuclear weapons are less significant in this role is clear, but it is difficult to say how much less.

G. CONVENTIONAL DISPLACEMENT OF NUCLEAR WEAPONS

Technical developments in non-nuclear weapons are profoundly affecting the requirements for nuclear forces. These dramatic improvements in conventional capability are not, of course, a consequence of the end of the Cold War but an ongoing development that started during the Cold War and continues today. The number of U.S.

⁵ James Schlesinger, "The Impact of Nuclear Weapons on History," *The Washington Quarterly* 16, Autumn 1993.

nuclear weapons peaked in 1967.⁶ The decline from that point forward resulted in large part from the retirement of widely deployed tactical nuclear weapons. The retirement of systems such as Genie air-to-air rockets, Davy Crockett surface-to-surface rockets, and nuclear artillery rounds was assured when guided conventional weapons could achieve adequately comparable military effectiveness without the great drawbacks of nuclear weapons. Advances in conventional capability continue so that the displacement of nuclear missions by conventional weapons continues. The Bulgarian railway bridge that confounded Admiral Turner would be attacked today with cruise missiles or laser-guided bombs, not a multi-kiloton nuclear bomb. Indeed, very few military targets *demand* the use of nuclear weapons.

H. SUMMARY

The following list reviews the major changes since the end of the Cold War that affect the calculus used to size our nuclear forces.

Table 1. Factors Affecting Force Size

Variable	Change Since Cold War	Change in Nuclear Force Size Calculation
Stakes	Very much reduced.	Proportionate reduction in threatened pain
Ideological content of contest	Much reduced	Major reduction in war goal
Targeting enemy economic recovery	Dramatically reduced or gone	Major reduction in depth and intensity of targeting
Conservative planning factors	Much reduced	Removes need for redundancy in targeting
Counterforce targeting	Uncertain, no longer hopeless for U.S.	Proportional to enemy target set, which is shrinking
Latent political utility	Reduced, but amount uncertain	<i>Allows</i> reduction, not clear how much it <i>encourages</i> reduction
Conventional weapon replacement	Extensive	Few missions <i>require</i> nuclear weapons, e.g., very hard targets, city annihilation
Target Hardness	Proliferation of hard targets and tunneling technology	A few very hard targets may require nuclear attack, <i>extreme</i> hardness makes mission impossible

⁶ This included stockpiled and inactive strategic and tactical warheads. The Soviets kept increasing their warhead count as long as there was a Soviet Union. “NRDC Nuclear Notebook, Global Nuclear Stockpiles, 1945-2000,” *Bulletin of the Atomic Scientists*, Vol. 56, No. 2 (Mar/Apr 2000), p. 79.

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IV. SIZING POST-COLD WAR NUCLEAR FORCES

U.S. nuclear forces serve multiple purposes. The appropriate number of weapons depends on what purposes they serve and the numbers needed to meet each requirement. I believe there are four potential justifications for nuclear weapons:

- Deterrence of attack by WMD
- Damage limitation
- Tactical war-fighting
- Political prestige and virtual power.¹

The last of the list is probably impossible to quantify. The first is difficult. But for the others, the following sections work through an attempt to put numbers to requirements.

A. DETERRENCE

Current discussions of nuclear deterrence often seem to be taking place in a vacuum. There seems to be near universal agreement that the main purpose of nuclear weapons is to deter attack with nuclear weapons. But why or where such an attack might occur is never more than vague.

For some groups who hate the West in general, and Americans in particular, terror attacks designed to kill Americans obviously have some intrinsic value. But no current nuclear power falls into that category and subnational terrorist groups that might obtain access to one or two weapons may well be undeterrable by *any* means appropriate for dealing with states. Other approaches to defense against these types of threats will have to be found.

¹ The Payne paper lists five: (1) deterring WMD use by regional powers, (2) deterring WMD or conventional aggression by global powers, (3) preventing catastrophic conventional loss, (4) unique targeting, and (5) enhancing influence. His first and second are subsumed in my first purpose, except deterring conventional aggression, which is my third. “Unique” targets is just counterforce. His fifth is equivalent to my fourth. Payne, p. 4.

If we hope to deter a Russian or Chinese or North Korean nuclear attack, we should know why they might launch an attack and what they hope to gain by it. If some important U.S. interest were threatened and the United States took moves to protect that interest, a nuclear-armed power could conceivably insist that we back away from actions defending that interest or they will attack the United States with nuclear weapons. The United States could, of course, make that a very unattractive option by threatening retaliation in return.

How many weapons are needed in this simplest of all deterrent models? Nations tend not to view an enemy's pain, *per se*, as a benefit. They do see pain suffered as a cost, however. While the Chinese may believe that the United States would not trade Los Angeles for Taiwan, they should be confident that there is a very real possibility that the United States could attack Shanghai (which has roughly half the population of all of Taiwan) if they attacked Los Angeles, regardless of what is going on with Taiwan. The Chinese will not see destroying Los Angeles as helping them in any direct way, only indirectly as a way to pressure the United States. But the destruction of Shanghai is a very real and direct cost to them. The asymmetry in how pain is perceived makes for a stable standoff, with all sides willing to make do with the status quo if the costs of doing nothing are less than the costs of trading nuclear attacks. Since nuclear weapons are so efficient at inflicting damage, it is almost always the case that the stakes are less than the cost of even the most limited nuclear attacks.

There can be cases in which a counteracting asymmetry works against the United States: the same stakes may be assigned different values by two observers. One can imagine, for example, a situation in which preserving the autonomy of Taiwan may be "merely" important to the United States but absorbing Taiwan may be viewed as absolutely vital to the Chinese. In a trivial sense, this problem is partly unavoidable. The United States cannot do everything and must set priorities, so some "challenges" simply aren't important enough for the United States to respond to. Stopping ethnic cleansing in Kosovo was more important than stopping it in Rwanda. So in one case America intervened and in another case it did not. At the opposite extreme, the United States recognizes the importance of a challenge and faces it squarely, for example the Soviet challenge to Europe. It is on the broad middle ground where problems appear to arise. Some seem to worry that situations will arise in which, on the one hand, the United States *must* address a challenge but, on the other hand, it will not be important enough to accept

any risk when facing the challenge. Asymmetric perceptions of stakes do not invalidate the general premise that the degree of threatened pain, times the credibility of response, that is required to deter is linked to the stakes involved. Asymmetric perceptions only mean that the United States has to size its deterrent forces based on how *others* perceive the stakes.

It is impossible to predict what the stakes might be or how valuable they might be perceived to be. But whatever the crisis, the stakes cannot be greater than national survival. So what are the number of weapons required to destroy an adversary country as a modern economy and society? How to do this is subject to some debate. In ranking the greatest engineering achievements of the 20th century (as measured by their benefit to mankind), the National Academy of Engineering ranked electrification as number one.² Thus, one example of an economy-destroying attack on a modern industrial nation such as Russia would be to destroy the electric generation capacity. Fewer than 500 generating plants produce the overwhelming majority of power in Russia. Current targeting doctrine places a high priority on high confidence that every target is destroyed, requiring multiple warheads against each target. In a pure retaliatory role, if the United States can destroy, say, 80 percent of Russian generating capacity and that would be enough, then which 80 percent is not critically important. Thus, even if our weapons have only 80 percent reliability, one designated warhead per target should be adequate, resulting in a requirement for 500 warheads. We need not convince the Russians of the certainty of destroying all of their generating capacity; other uncertainties of retaliation overwhelm the uncertainty of whether 80 percent or 90 percent of the sites are hit and which particular ones are hit. Fewer weapons might suffice if the United States threatened more fearsome attacks. For example, the 10 largest cities in Russia contain about 15 percent of its population. If retaliatory attacks should be sized to the stakes involved, then these sorts of attacks would cover any currently conceivable post-Cold War stakes between the United States and Russia or China. Other countries, for example, North Korea, would still be lesser included cases because the target base is smaller.

There are several ways in which this threatened retaliation could fail to deter. Both sides could see how the exchange might play out. The Russians, for example,

² <http://www.greatachievements.org/greatachievements/indexp.html>. To supply some perspective to those dazzled by computers, computers are ranked number 8, right behind agricultural mechanization.

destroy New York, the United States destroys Moscow, then Russia destroys Chicago, the United States, St. Petersburg, and so on. (If attacks on cities seem implausible, then replace cities with oil refineries, power plants, military installations, or any other type of target. If the sequential exchange of targets seems implausible, then assume that attacks occur in groups.) If the United States believes that Russia would take these actions, then it can look ahead to the end of the exchange and see that, whatever the fight was about, it was not worth the costs and not begin the nuclear exchange or, in reality, not be able to plausibly *threaten* to begin the exchange. This is just another way of saying that the nuclear deterrent has been mutually checkmated, which was exactly the problem the United States feared when confronting the Warsaw Pact in Europe. This was a major concern when America believed it was vulnerable to conventional attack in Europe, but the situation has been largely reversed: in areas of the world of U.S. interest, the United States has adequate conventional military power. If the Taiwanese and the Americans acting together can forestall a conventional attack across the Straights of Taiwan, then it is the Chinese who must worry that their nuclear forces are checkmated.

With much reduced nuclear forces, does relative force size matter? If the Russians, for example, retained large nuclear forces while the United States reduced to only a few weapons, then the United States could see that, after the first 10 cities had been attacked in the scenario above, it would be unarmed and the Russians would still have many warheads left and many cities to threaten. Anticipating this, America would concede its original interest even before the exchange began. Is this a plausible vulnerability?

There is one potentially important difference between calculating payoffs in the above highly asymmetric case and in a more balanced case. Specifically, calculation of payoff in the asymmetric scenario has two parts: the first is the value of the resolution of the conflict that initiated the exchange, that is, the “stakes” involved. The other is the benefit to be gained by the enemy nuclear power from having the United States disarmed at the end of the exchange. This second benefit is potentially large but still finite. An enemy would presumably be unwilling to suffer economic and social collapse in exchange for dictating peace terms to a partially destroyed United States. Beyond a certain level of damage, the enemy’s economic structure would be so debilitated that it would not be able to capitalize on any concessions it could extract from the United States. Thus, for deterrence purposes, America could unilaterally reduce to levels of survivable

warheads sufficient to destroy the enemy economy while, beyond that, warhead numbers on both sides would have to be linked to avoid presenting the additional payoff of disarming the United States.

As discussed above, the force levels need to be tied to the stakes involved. Compared to the Cold War, the stakes are now dramatically reduced, so the deterrent forces can be reduced. But the deterrent (in this simple model) is a product of consequences times likelihood. Either side could achieve a lower deterrent by reducing forces, hence reducing the consequences of an attack. But either side might prefer to lower the *likelihood* of attack, that is, have a deterrent that leaves less to chance than Schelling saw in the Cold War and maintain the same consequences, that is, force size. Thus, a “reduced” deterrent could be a smaller force, or it could be the same force with tighter command and control, Permissive Action Links (PALs), de-alerting, and so forth.

B. DAMAGE LIMITATION

In contrast to the deterrent mission, the number of weapons needed for damage limitation depends very much on the numbers, types, and basing modes of weapons held by potential enemies and the degree to which enemy forces are to be degraded and the required confidence of reaching damage-limiting goals.

The criteria set for damage-limiting counterforce attacks will tend to be very stringent, almost all or nothing. Any nuclear attack will be horrendous, but an attack by 10 weapons will be less horrendous than one by 20. Thus, a damage limiting counterforce strategy will try to eliminate, not just whittle down, the enemy’s nuclear forces. At large numbers, this may seem hopeless, that is, some may judge that there is no useful distinction between an attack with a thousand warheads and one with two thousand and, if that is the ultimate difference of counterforce, then the mission is not worth pursuing. So, perhaps paradoxically, as nuclear arsenals on both sides become smaller and can inflict less damage, usable counterforce become more plausible and interest in counterforce missions increases.

The size of a counterforce arsenal is related to the number of enemy targetable delivery systems. Russia currently has a far larger U.S.-threatening arsenal than does China, so we can focus just on Russia for this analysis. The Russians now have 380 silo-

based ICBMs.³ The feasibility of hitting other targets depends on their alert status. The Russians also have, for example, 36 SS-24s on 12 trains and 360 road-mobile SS-25s. The SS-25s are in 10 unhardened garrisons when not on alert. The Russian air force is in serious trouble and of dubious effectiveness⁴ but would be attacked in any case. During normal peacetime alert, Russian strategic aircraft are stationed at two bases. If alerted, they would have between 200 and 300 runways available of adequate length.⁵ When in port, SSBNs present probably fewer than a dozen targets. Once alerted and out to sea, nuclear barrage tactics are at least conceivable but SSBNs would be targeted primarily by non-nuclear means, specifically conventional torpedoes.

Because of the important differences in the alerted and non-alerted target set, sizing the counterforce arsenal requires decisions about when the United States would attack Russia. Counterforce requires a preemptive first strike,⁶ but the important question remains whether U.S. counterforce strikes should be sized for attacks before or after the enemy has dispersed mobile systems. Russia has had periods in the past when it has not had any SSBNs on patrol, and it does not routinely disperse the road-mobile SS-25s. Combined with obvious gaps in their early warning coverage, a successful “bolt-out-of-the-blue” attack by the United States is technically possible.

³ *The Military Balance*, International Institute for Strategic Studies, 1999-2000, p. 112.

⁴ Craig Covault, “Russian Air Force Faces Deepening Crisis,” *Aviation Week & Space Technology*, Vol. 154, No. 10 (5 March 2001), pp. 60-63.

⁵ Central Intelligence Agency, *The World Factbook 2000*, 1 Jan 2000, <http://www.odci.gov/cia/publications/factbook/geos/rs.html>.

⁶ This seems obvious but apparently often difficult to admit publicly. The convoluted debate in the Congress about the MX ICBM is illuminating. One Senate debate summary includes arguments by supporters of the MX that “...our Minuteman III force is no longer sufficiently effective as a counterforce to a first strike by the Soviets.” This raises obvious questions about what a U.S. “counterforce” attack is shooting at once the Soviets have launched their missiles in a first strike. But the answer seems to be “The desired strategic force posture requires the silo-buster MX as a counterforce weapon.” Yet, lest that appears too aggressive, the next paragraph of the summary offers the reminder that “At this point, we should dispel the notion that the MX provides the United States with a first-strike capability. Deployment of the missile will not establish such a capability, as a strictly military analysis shows. Furthermore, and more fundamentally, we do not seek such a capability. We possess nuclear weapons to maintain peace and defend freedom through a strategy of deterrence, which is defensive in nature. We have no operational plans to launch a first strike and never will. It is against our nature as a people.” [See *Senate Record Vote Analysis: Defense Appropriations/MX Missile, Department of Defense Appropriations Act, 1984 (H.R. 4185). Bumpers et al. amendment No. 2505, 98th Congress, 1st Session, 7 November 1983.*] It may very well be against our nature as a people but the United States had, at the time, detailed plans for a damage-limiting first strike against the Soviet Union. Damage-limiting attacks make no sense unless they are first strikes.

Adding up the missile silos, missile garrisons, bomber and submarine bases, there would be, before Russia goes on alert, just over 400 weapon aim-points. A counterforce strike demands higher confidence than a countervalue attack so at least two warheads would be targeted on each weapon site. Particularly lucrative targets, for example, bomber and submarine bases, would probably warrant more than two warheads apiece, but the total number of U.S. warheads required could be less than 1,000. With an 80-percent success rate per warhead attacking silos and two warheads attacking each silo, 4 percent of the original Russian silo-based ICBMs would survive. Assuming success against the bombers, mobile missiles in garrison, and submarines, about 19 silo-based missiles would survive, a mixture of SS-18s and SS-19s armed with approximately 150 warheads. This is still a formidable threat to the United States, but perhaps circumstances could occur in which reducing the threat to this level would be worth the risks of a first strike.

When Russia goes on alert, many of their weapons would be much more difficult to destroy. The size of the necessary counterforce arsenal would then depend on whether the United States still tries to attack dispersed Russian weapons or gives up on them.

Once the bombers dispersed, the number of aimpoints would depend on U.S. intelligence. If the United States knew where the bombers were, it could attack those sites, with the number of sites depending on how many bombers the Russian could get airborne, perhaps dozens. If U.S. intelligence did not reveal the locations of the bombers, then all the airfields that were potentially available would have to be attacked, approximately 300. The number of U.S. warheads required for attacks on the Russian air force would, therefore, range from fewer than 100 to approximately 600.

Mobile ICBMs present a different targeting problem. Road-mobile ICBMs deploy to areas, not sites. The options for destroying them are to search them out individually or barrage the deployment areas. The prospects for detecting individual missiles depends on the reconnaissance assets available. But searching takes time, and the missiles can continue to move so locating all of them at any one moment is unlikely, making simultaneous attack impossible. Barrage attacks, on the other hand, could be simultaneous. Depending on the area to be barraged, they could, however, require thousands of warheads. Assume that mobile missiles are vulnerable to a 10 pounds per square inch (psi) overpressure and can travel 30 km/hr, then 1 hour after deployment, they could be within a circle of approximately 3,000 km². A 1-megaton bomb creates a

10 psi overpressure out to about 4.5 km, or more than an area of approximately 60 km². Thus, 50 equivalent megatons would be required to barrage the potential deployment area. If the missiles had a day to deploy, they might be anywhere within a circle of, say, 500 km or within an area of almost 800,000 km² requiring some 13,000 equivalent megatons for effective barrage. In practice this number will be smaller because the missiles cannot go everywhere, will be funneled over bridges, and so forth. But even with more realistic calculation of potential deployment areas, the number of attacking warheads is prohibitive.

Barrage attacks against SSBNs are even more problematic. Indirect attacks might be feasible, however. U.S. SSBNs go out to sea, disappear, and operate independently. Russian naval tactics call for the surface fleet to deploy to protect SSBN patrol areas. Barrage or point attacks on the surface components could be a prelude to sending in SSNs to find and attack the Russian SSBNs. The number of warheads required would range from the dozens for point attacks to tens of thousands for barrage attacks. This approach does not destroy Russian SSBNs quickly and therefore does not preclude launch of their missiles.

In addition to attacks on intercontinental weapons, a counterforce attack would most likely attempt destruction of other supporting facilities, for example, command and control nodes and nuclear weapon storage areas. The Russians have approximately 90 storage areas.⁷ The number of communications targets is more ambiguous and could be very large indeed if every node in every communications net were targeted.

C. TACTICAL WARFIGHTING

During the NATO-Warsaw Pact confrontation, there was the potential for battlefield use of thousands of tactical nuclear weapons. The purpose of nuclear use on the European battlefield was two-fold: first, to compensate for NATO's perceived conventional vulnerabilities; second, to raise the risk of a wider nuclear war up to and including central strategic systems, thereby dissuading the Warsaw Pact from attacking in the first place. Although neither of these specific motivations exists today, nuclear weapons could be used in a future regional war for any of a variety of reasons. The

⁷ William Arkin, Robert Norris, and Joshua Handler, *Taking Stock: Worldwide Nuclear Deployments 1998* (Washington: Natural Resources Defense Council, 1998), p. 1, Table 1.

Persian Gulf War can serve as one model. Congressman Dan Burton argued on the floor of the House that the calculation was simple: if use of nuclear weapons could reduce American casualties, then the United States should consider the use of nuclear weapons. But one clear observation that could be drawn from the Persian Gulf War is that the United States and its allies won an overwhelming military victory without resort to nuclear weapons.⁸ But they *could have* been used, so the war provides one concrete example of the types of targets that some future war might present. Table 2, taken from Gulf War after-action reports, shows “strategic,” that is, non-battlefield targets, as of December 1990.⁹ This list of targets was considerably longer than the pre-crisis list.

Table 2. Theater Strategic Targets in the Persian Gulf War

Target Category	Number of Targets (As of December 1990)
Strategic Air Defense	27
Chemical, nuclear, biological	20
Leadership	27
Command, control, communication	30
Electric power	16
Oil	8
Railroads	21
Airfields	25
Naval ports and facilities	4
Military support facilities	46
Scuds and facilities	13
TOTAL	237

All of the above target categories were attacked with varying degrees of success using conventional, including precision-guided, munitions. For example, 88 percent of Iraqi electrical production was taken out of service, the remaining 12 percent coming from smaller generating plants that were never targeted,¹⁰ and 90 percent of the oil refining capacity was destroyed or taken out of production.¹¹ Similar success was

⁸ McGeorge Bundy, “Nuclear Weapons and the Gulf,” *Foreign Affairs*, Vol. 70, No. 4 (Fall 1991), pp. 83-94.

⁹ Thomas Keaney and Eliot Cohen, *Gulf War Air Power Survey: Summary Report* (Washington, DC: U.S. Government Printing Office, 1993), p. 42, Table 2.

¹⁰ Keaney and Cohen, pp. 73-74.

¹¹ Keaney and Cohen, p. 76.

obtained in attacks on Iraqi airfields. Because of the time required for repeated attacks against hardened aircraft bunkers, many Iraqi planes were, however, able to flee to Iran, where they were impounded but not destroyed. Not all the target sets were attacked so efficiently. More than 480 separate attacks were directed at leadership and communications targets, but the effectiveness of the attacks is difficult to judge except to say that Iraqi communication and command never completely broke down.

The use of nuclear weapons in theater war is most often considered in the context of response to the use or threatened use of other weapons of mass destruction. The Persian Gulf air campaign included attacks on chemical, biological, and nuclear production facilities and Scud launchers that could deliver these weapons of mass destruction. These attacks met with mixed success. There were 1,500 sorties against Scuds. Nearly half were against fixed facilities. These included culverts and highway overpasses for which there might have been no evidence of the presence of Scuds but which did provide potential hiding places. Another 215 attacks were against mobile launchers, the great majority of which were not successful (including “successful” attacks against what turned out to be decoys and misidentified targets, often fuel trucks).

The attack on nuclear infrastructure was limited by the ability to identify targets, not the ability to attack them. As of January 1991, two nuclear facilities were designated targets, but after the war UN inspectors uncovered more than 20.¹² The story for chemical and biological targets was similar. Indeed, even with UN on-site inspections, the outside world will probably never know just how many weapons facilities there were to target. The main storage areas were only the largest chemical targets. After the war, the UN estimated that Iraq had 150,000 chemical munitions.¹³ Once these get out into the field, they become tactical battlefield targets, discussed next.

Thousands of sorties were flown against tactical targets on the battlefield in support of the ground war. Some of these were attacks with individual guided munitions against individual vehicles and not the kinds of targets at which it would be worth shooting nuclear weapons. The B-52s, however, flew 1,175 missions against “GOB” or

¹² Keaney and Cohen p. 79.

¹³ Keaney and Cohen, p. 81.

General Order of Battle targets, that is, sorties in which they delivered massed unguided bombs onto area targets in support of the ground war.¹⁴

What does the Persian Gulf War tell us about the numbers of nuclear weapons that might be needed in theater-level conflicts? In the actual war, the number of nuclear weapons that turned out to be required for a resounding victory was precisely zero. If the B-52 GOB targets and other strategic targets, for example, oil and electricity, were given to the nuclear mission, then the number of 1-2 kiloton weapons used could easily exceed a thousand, so we can take that as an upper bound.

Nuclear weapons could be used simply for the sake of economy. Iraq had 25 airfields with aircraft stored in individual hardened revetments that had to be struck individually, sometimes more than once, resulting in hundreds of attacks being directed at these 25 airfields. Any of the airfields could have been destroyed together with all the aircraft on the site, with a single nuclear warhead of several tens of kilotons yield. Similar, if somewhat reduced, efficiencies would be available for other target types. For example, oil refineries, which required multiple attacks with conventional munitions, could be destroyed with single nuclear warheads. Nuclear weapons can make damage assessment easier as well. For example, a conventional attack on an optic fiber relay center can destroy all of the above-ground facility while the buried optic fibers remain untouched.¹⁵ A nuclear bomb that leaves nothing but a smoking crater allows confident assessment of target destruction.

Nuclear weapons could be used to attack enemy weapons of mass destruction. Before the air campaign began, there were 20 designated nuclear, biological, and chemical (NBC) target sites that were attacked with conventional weapons but could have been attacked with nuclear weapons. Success of conventional attacks against the delivery systems, that is, the Scuds, is difficult to judge. Many “targets” were hit, but some unknown number of these were decoys, other vehicles such as fuel trucks that were misidentified as Scud launchers, or they were “presumed” Scud targets (for example, a culvert where a Scud was assumed to be). A nuclear campaign against the Scuds could have used hundreds of airbursts of weapons in the few to multi-tens of kiloton range.

¹⁴ Eliot Cohen, *Gulf War Air Power Survey Vol. V: A Statistical Compendium and Chronology* (Washington, D.C.: U.S. Government Printing Office, 1993), p. 418, Table 177.

¹⁵ Cohen p. 67.

However, the limit on the ability to attack Scuds was due to a lack of even general, much less precise, location information. Therefore, even a powerful area weapon like a nuclear bomb would not have been able to compensate for uncertainties in target position.

Some of the targets discussed in the survey were difficult to hit and damage assessment was sometimes uncertain and some were hit several times. However, none were judged immune to conventional attack. In future conflicts, however, an enemy might choose to bury key assets precisely because conventional attack is possible. The only way to attack such a target directly might be nuclear weapons.

Existing tunneling technology creates two problems when trying to determine how many nuclear weapons to set aside for deep targets. Tunneling is becoming easier and cheaper, and tunneling equipment, created for a variety of civilian applications, is widely available on the international market. The first problem is, therefore, that tunnels can be proliferated almost at will. And second, because tunneling is cheap, tunnels can go as deep under mountains as required to make the cavities immune even to nuclear attack.¹⁶ Thus, a basic question of how such targets are to be defeated must be addressed before any estimate of the required number of nuclear weapons can be made. Can deep targets be attacked directly? If they can, is that the most efficient method, or should entrances be blocked so that air, power, and water inputs are disrupted? Or should any potential weapons inside be attacked as they exit the safety of the tunnel? The answers might be different for different types of weapons. For example, if political or military leaders take shelter in deep tunnels, they are “defeated” if all other links in the communication and command net can be attacked. The deep target then becomes an invulnerable, but isolatable, node in an otherwise vulnerable network. Missiles hidden in tunnels might be able to exit and fire weapons of mass destruction before countering fire could arrive, so the tunnels would have to be attacked directly, which may not be possible with conventional weapons. Thus, the number of nuclear warheads required is equal only to those deep targets that can be, and need to be, attacked directly. For example, if NBC deep targets were to be attacked directly, and assuming that real targets can be

¹⁶ For a Colorado water project, a commercial firm recently finished a tunnel just short of 10,000 feet long. The 10-foot diameter tunnel was extended 219 feet through hard rock in one record-breaking 12-hour shift. From the online version of *Tunneling Business Magazine*, <http://www.tunnelingonline.com/news.html#Colorado>, July 2001.

distinguished from decoys, then the number in a replay of the Iraq war would be roughly equal to the number of NBC targets, that is, about 20.

Calculations of the use of battlefield nuclear weapons in a confrontation with Russia or China are entirely different. Russia has thousands of tactical nuclear warheads, and China has at least hundreds. The precise number is not known and most likely never will be. Presumably, either country would consider using those weapons if it were invaded by the United States. Moreover, they would, no doubt, take a very different view of their own nuclear weapons exploding over their territory and U.S. nuclear weapons exploding over their territory, presenting the United States with a problem of how to respond. Whether a U.S. expeditionary force could survive in Russia or China in a tactical nuclear environment is not clear, but to make the attempt might require quite liberal use of nuclear weapons, both to attack nuclear systems and to attack conventional forces, causing them to disperse, thereby allowing a more effective defense. Detailed numeric requirements would demand detailed campaign analysis, but assuming an operating area would have a perimeter of hundreds of kilometers and a nuclear weapon might attack tactical targets less than a kilometer in diameter, the number could easily run into the hundreds.

D. VIRTUAL POWER

Finally, nuclear weapons may serve some purpose by providing political prestige or “virtual” military power aside from any explicit military application. Whether or not this is true depends on whether anyone believes it is true. If, for the sake of argument, it could be proven that 1,000 warheads were exactly enough for any conceivable warfighting or deterrent mission, would it then make any difference if the United States had 1,000 warheads and the Russians had 4,000? Harold Brown, quoted above, and others think it did make some non-quantifiable, but non-negligible, difference during the Cold War. Many have that view today. In a recent op-ed piece a U.S. Congressman wrote,

The lower we make the threshold for becoming a world power, the more tempting it becomes. There may not be an appreciable difference whether the U.S. has 7,000 or 4,000 weapons. Even 2,500 weapons may seem unreachable for an emerging nuclear power with a few dozen weapons on hand. But matching a U.S. stockpile of 500 or 1,000 weapons may seem much closer and much more achievable, both practically and

psychologically. We do not want to lower the bar so much that others are encouraged to try to jump up and reach it particularly those who see nuclear weapons as a shortcut to global influence.¹⁷

Note that “becoming a world power” is defined by the number of nuclear weapons possessed, and not with respect to a military need but with respect to other global powers.

To translate the virtual utility of nuclear weapons into arsenal size requires that several questions be addressed. Is there any correlation between the virtual utility of nuclear weapons and military utility, in particular, what level might embolden potential rivals? Do U.S. nuclear arsenals have to be sized in relation to those of rivals independent of military utility? Are nuclear weapons useful for anything other than countering other nuclear weapons? What level of nuclear arms makes us feel comfortable, in particular, when do we know we have too many or too few? Should the United States try to change world perceptions toward nuclear weapons and, if so, in which direction?

If one of the main hypotheses of this paper is correct, that the military utility of nuclear weapons has always been difficult to specify and quantify and the size of the arsenal has, therefore, always had a large arbitrary component, then the correlation between perceived utility of arsenal size and actual military utility is necessarily weak because perceptions cannot depend strongly on something that is unknown. (Perceptions can, of course, depend strongly on *beliefs* about something that is, in fact, unknown, for example, the number of nuclear weapons needed for deterrence.)

If nations believe that nuclear weapons confer some political leverage beyond their military utility, then they almost certainly do. Moreover, even if a nation does not believe that mere possession of large numbers of nuclear weapons confers some useful political leverage, it might be forced to compete in the nuclear arena if its rivals believe such leverage exists. For example, if China believes that possession of a nuclear arsenal comparable to that of the United States allows it to behave more aggressively than it otherwise would, then it may build up its arsenal and behave more aggressively, and the United States would have to deal with that aggression, whether warranted or not.

It is probably impossible to determine what the leaders of Russia, China, and the United States believe about the virtual power conferred by nuclear weapons because any

¹⁷ Congressman William M. “Mac” Thornberry (R, Texas), The Washington Times, 15 June 2001.

answer to the question would better reflect what they wish others to believe than what they actually believe. While the Russians clearly accept that nuclear weapons help maintain some vestige of great power privilege, there is serious debate within Russia about the allocation of resources between nuclear and conventional forces. Although we may be wary of what other nuclear powers say, we can observe what forces they are building. The Russian debate, for example, is taking place within the context of a sharp overall decline in nuclear force size and readiness. Most observers believe the Chinese will continue to build up their currently very small intercontinental nuclear arsenal, but there is little indication that they are aiming for a U.S.-sized force, at least for their intercontinental-range weapons. Based on the directions that arsenals are taking, no country currently has an intercontinental warfighting strategy as a goal, except for the United States. The developments in other nations' nuclear arsenals suggests that currently the United States is the only nation that *clearly* puts much value on the "virtual" power of nuclear weapons beyond the number needed for minimal deterrence.

E. SUMMARY OF THE USES OF NUCLEAR WEAPONS

If we choose to have nuclear weapons as a deterrent force, and a sufficient deterrent is destruction of the Russian economy, and if attacks on power generation would effectively destroy the economy, then no more than 500 weapons would be required. Clever targeting could, no doubt, reduce that further.

Warfighting requirements depend on whether we want to be able to attack alerted or only non-alerted Russian forces. Non-alerted forces might take as few as 1,000 weapons, while attack of alerted forces, if possible at all, could require an order of magnitude more and still not be disarming. If the United States wanted to conduct effective counterforce, it must make the decision to attack Russia at such an early stage of a crisis that the Russians have not yet dispersed their forces.

If we choose to use nuclear weapons on the battlefield, the numbers could easily go up into the hundreds or thousands, but truly appropriate nuclear targets in a theater like Iraq would probably never amount to more than a score (and, in fact, Iraq was defeated with zero nuclear weapons). Currently, there would probably be no political support for such profligacy in a Persian Gulf-like conflict, although there may be in a larger war with a more formidable opponent.

The virtual power conferred by nuclear weapons is impossible to quantify so the resulting “required” numbers can never be more than guesses. Thus, numbers of nuclear weapons required, depending on the mission assigned them, run from dozens for theater “strategic” targets, through hundreds for a “minimal” deterrent, to thousands for tactical warfighting.

V. THE FUTURE ROLE OF NUCLEAR WEAPONS

Nuclear weapons create myriad contradictions. These contradictions have forced us to policies that were always difficult, paradoxical, uncomfortable, and dangerous. Many of the paradoxes remain, but the range of choice is now immensely greater. During the Cold War, the stakes were too high, the risks too great, to take many chances. Circumstances at times forced us into nuclear postures that we didn't like but couldn't find alternatives to. With the end of the Cold War, we and the Russians and Chinese are no longer "scorpions in the bottle." Now we have choices.

Nuclear weapons present complex policy questions and the few answers that can be provided do not come with rigorous proofs. Nevertheless, some facts seem inescapable:

1. The United States has conventional military dominance in the world today and for the foreseeable future.
2. The only threat to the very existence of the United States as a nation and society comes today from nuclear weapons (although some forms of biological attack might arise in the future).
3. If nuclear weapons disappeared, could be un-invented, and the laws of physics adjusted to make them unworkable, then the security of the United States would be enhanced profoundly.
4. Nuclear weapons will not disappear and they can't be un-invented.
5. Although nuclear weapons largely checkmate other nation's nuclear weapons, any one-sided advantage in nuclear weapons could present a nation with immense potential for blackmail against the United States.

If these observations are correct, then the course that would maximize the security of the United States by emphasizing our strengths and reducing our vulnerabilities would be to conventionalize military power and de-emphasize nuclear weapons to the greatest extent possible short of abolition. The United States could use its leading position to delegitimize nuclear weapons. It could unilaterally reduce its nuclear force to a minimal "full" deterrent, suggested above as 500 warheads but probably fewer. In coordination

with other nuclear powers, it could reduce below 500. It could seek to discourage the development of new nuclear weapons and the rise of new nuclear powers. It could accept small uncertainties in the reliability of its deterrent in exchange for huge uncertainties in any other nation's ability to mount a coordinated first strike or a nascent nuclear power's confidence in its untested nuclear weapon.

Perceptions often do not change smoothly over a continuum of possibilities. Often a view is held that is supported by the available facts, then those facts can slowly change while the perception holds firm until some threshold of contradictory evidence is passed and the perception suddenly shifts to another point. Paul Chrzanowski makes interesting explicit arguments for such a bimodal distribution of attitudes toward nuclear weapons.¹ He believes that the key is which of two conflicting beliefs is dominant: either that nuclear weapons contribute to our security or that they are part of the threat to our security. Our approach to nuclear weapons will be determined by one perspective or the other, he argues, with any "compromise" approach between being the worst of both. He does not even attempt to prove his contention but some effect like this would explain the lingering effects of Cold War thinking about nuclear weapons. In any case, to the extent that he is correct, the problem of perceptions is greatly simplified because we can focus on the two extremes and pass over the infinite gradations in between.

A. NUMBER OF WEAPONS

Ironically, if we believe nuclear weapons contribute to security, then we will size our arsenal at the level at which we believe we have too many and, if we believe that nuclear weapons threaten security, we will size our arsenal at the level at which we believe we have too few. I discussed above how, during the Cold War when we believed that nuclear weapons contributed to our security, we were not certain how many were enough so we built weapons until everyone was quite confident that, whatever "enough" was, we were well past that point. We stopped when we had too many, typically determined by what we thought we could afford to spend on nuclear weapons. In other words, when we thought that nuclear weapons contributed to security, we stayed so far away from having too few that the issue of how many is too few never arose.

¹ Paul Chrzanowski, "Strategic Reductions and Defenses in a Multipolar World: Complementary, Crosswise, or Congruent?" a Lawrence Livermore National Laboratory briefing presented at IDA for the State Department Conference on Stability, 30 November 2000.

If the perception shifts to the other side so that nuclear weapons seem part of the threat to our security, then we will want to be so far away from the “too many” side that the details of how many are too many will become irrelevant and we will try to get down to the smallest number we can, that is, reduce until we fear we have too few. Clearly, at low levels, cost will not be the limiting factor so we must examine other indications that we have reduced as far as we can.

The indicators that we may have reduced the number of nuclear weapons too far will fall into the following categories:

- Deterrence needs and military utility
- Responses by potential nuclear rivals
- Intelligence warning time
- Effect on allies.

Even if there is no perceived value to the mere possession of nuclear warheads, they will still have real military and deterrent value. As discussed above, 500 survivable warheads should be adequate to destroy the electric generating capacity of Russia. If we consider this a “full” deterrent (that is, not a warfighting force but one able to sufficiently limit a nuclear rival as an industrial power that it would deter any currently conceivable adventure), then we should be able to reduce to 500 survivable warheads, absent any virtual warhead value. (If the conceivable stakes are less, the deterrent can be smaller and presumably the arsenal proportionately smaller.)

If 500 warheads (or some other number) are deemed adequate for minimal but “full” deterrence, then an enemy could not win any retaliation-in-kind exchange with the added bonus of having disarmed the United States. At lower levels, however, an enemy would see the additional bonus of having the United States disarmed at the end of any exchange, so reductions below this level must be coordinated with other nuclear powers.

Some have raised concerns about the possible reactions of potential nuclear rivals to argue against substantial reductions in the U.S. nuclear arsenal. In particular, that reductions in the U.S. arsenal will lower the threshold for nuclear great power status, thereby tempting potential rivals to compete when they otherwise would realize that the game was hopeless. For example, in addition to Representative Thornberry's statement previously quoted that "We do not want to lower the bar so much that others are encouraged to try to jump up and reach it..." Keith Payne wrote that "Maintaining a

numerical edge may usefully signal a U.S. readiness to compete with aggressive rivals, raise an entry barrier to states aiming to become major nuclear powers, and thus possibly prevent such challenges in the first instance."² These concerns are usually directed specifically at China. That is, if the United States maintains a large nuclear arsenal, then the Chinese would calculate that competing numerically with the United States is beyond their means, and settle for some small arsenal, but, if the United States were to reduce the size of its arsenal to the point where China could imagine building up to U.S. or comparable levels, then they would be tempted to do so to challenge U.S. nuclear supremacy. Thus maintaining the status quo is the least risky U.S. path.

Just sticking with the status quo is often the most attractive and least controversial option for a variety of reasons. The United States can maintain its current arsenal of several thousand weapons for years into the future for a small fraction of total defense spending. Moreover, many expect the Russians to reduce the size of their arsenal whatever the United States does because they simply cannot afford to continue with the forces they have. Thus, the cost to the United States of the status quo appears small while it avoids a risk from the Chinese that is uncertain, and Russian arms reductions come as a bonus regardless.

Clearly, it is Chinese, not U.S., nuclear weapons that potentially threaten the United States. What must one believe in order to accept the "lowering the bar" argument, that U.S. reductions will *increase* the Chinese threat? Let's apply some arbitrary, but reasonable, numbers to make the following discussion simpler. Say the United States will settle down to a long-term arsenal of 5,000 intercontinental warheads and the Chinese start from their current 20 or so. The "lowered bar" argument is that the Chinese might build up to 200 or so warheads. But, realizing that they will never reach 5000, they stop at that point, satisfied with a force 4 percent as large as that of the United States and judging that they have some minimal deterrent force even if they are not equal competitors. If the United States reduces to 500 warheads, however, then the Chinese, realizing that they could afford to match the United States, would not be content with what is now 40 percent of U.S. arsenal size and would not stop at 200 but build up to 500. Thus, so the argument goes, reducing U.S. warhead numbers would actually increase the number of weapons facing the United States.

² Payne, p. 9.

The Cold War experience with non-U.S. nuclear powers is restricted. Friends of the United States, that is France, Britain, and Israel, seem to have set themselves a level of force that they judged, by some measure, was adequate and stayed with those force levels more or less independently of what the superpowers were doing. Perhaps U.S. friends only wanted some basic deterrent forces, but perhaps their friendship with a nuclear superpower was the cause of their limited nuclear ambitions, that is, each judged that it needed only enough of a nuclear force to draw the United States into any nuclear confrontation. The Soviets, from the beginning of the Cold War, were determined to match, and eventually exceed, the U.S. arsenal.

Are the Chinese developing a nuclear arsenal based on some *absolute* goal, or are they going to build up forces *relative* to the size of U.S. (and perhaps Russian or Indian) arsenals? The Chinese have built a significant number of short- and intermediate-range nuclear weapons. Their long-range systems are few now, but most analysts predict that the number of these systems will grow. Whatever the Chinese attitude toward nuclear weapons, it can be observed that the Chinese at present seem to lack a Cold War-like urgency toward building up their long-range forces. No attempt will be made in this paper to predict the Chinese attitude. However, if we are to accept the "lowered bar" argument, then we must not only believe that the Chinese are currently "absolutist" about their arsenal size (that is, satisfied with some fixed number more or less independent of U.S. force size), but also would remain so in the face of a long-term U.S. advantage and, moreover, that they would convert from absolutist to a "relativist" or competitive view if the U.S. arsenal fell below some threshold. Experience is too sparse to draw any firm conclusion. But observation suggests that those nations that set themselves limited goals kept limited goals, while the Soviet Union, which began as competitive, always remained so is at least suggestive. Certainly our limited experience does not show that it is inevitable that the Chinese would jump up for a "lowered bar."

If China is absolutist, then it will build up to some level that it judges to be adequate and affordable, fairly independent of what America does, so the United States could reduce its arsenal from 5,000 to 500 with no *increase* in the number of nuclear warheads threatening the United States. If China is relativist, whether it intends to maintain 10 percent or 100 percent of U.S. force size, reductions in the U.S. arsenal would directly *reduce* the threat the United States faces. Only if U.S. force reductions induce a change in the Chinese force-sizing approach from absolutist to relativist is there

a potential that U.S. force reductions could produce a greater threat from China—and then only the potential, not the certainty. If the Chinese relativist requirement were for parity and their absolutist requirement was for 200 weapons, and if U.S. reductions to 500 warheads induced the shift, then it would indeed lead to an effective increase in the number of Chinese weapons. But if their absolutist requirements were for 1,000 warheads and their relativist requirements were for parity (or half the U.S. force), reductions by the United States to 500 would lead to fewer Chinese weapons even with a shift in approach to sizing. We must add to the balance the likelihood that Russia has inherited some of the competitive culture of the Soviet Union and, whatever its financial constraints, will be prone to larger rather than smaller force reductions if the U.S. forces decrease.

These arguments do not, of course, *prove* that reducing U.S. forces will reduce the nuclear threat faced by the United States, but they do suggest that only special combinations of circumstances will cause U.S. force reductions to increase the threat. Should the United States take the chance and reduce forces substantially? If one believes that the required special combination of circumstances will, in fact, obtain, then definitely not. If the combination does not obviously obtain, then the calculation depends on the risks involved. One potential risk is that the United States could make major reductions while rival nations rapidly build up. For, example, in arguing against deep reductions, Payne states, "It is not now possible, for example, to anticipate with confidence the requirements for nuclear deterrence over the course of the coming *two or three decades*," [emphasis added].³ I believe that concerns about the United States being left behind after major reductions, even when warning times might be "two or three decades," are flatly unrealistic and unsupported by economic or historical analysis. The United States has the world's largest economy and most sophisticated industrial base. No other nation can exceed its industrial potential for the foreseeable future. The fear might be that the United States *could* expand its arsenal in response to an emerging threat but, in fact, would not. This also is not supported by experience. It has been reported that between 1957 and 1967 the stockpile of U.S. nuclear weapons grew from 5,828 to 32,500, well over 2,000 per year.⁴ When faced with a threat, the United States clearly can and *does* respond. Even so, another risk raised by Payne is the ability to respond even if the

³ Payne, p. 3.

⁴ NRDC Nuclear Notebook, *ibid.*

United States has the will. As he writes, "Restarting production of a weapons system, let alone designing, testing, and building a system from scratch after the production infrastructure has atrophied, is a complex endeavor that, *if possible*, would take many years" [emphasis added].⁵ Essentially, this suggests that something the United States could once do, something that, when it did it for the first time, it did without any infrastructure in place, even sometimes without the full understanding of the necessary science and engineering, it cannot do again. The idea that the United States could once invent atomic bombs, solid fuel missiles, intercontinental bombers, or whatever, and could somehow lose the fundamental ability to ever replicate them, like some lost art of medieval stain glass manufacture, is simply implausible. Clearly the United States might decide not to, just as it is unlikely to decide to replicate the Apollo program, but it could.

Of course, everything takes some time and, outside the urgency of wartime, response times can be measured in years because of the normal slow pace of government decision-making. One response is to keep an unnecessarily large nuclear arsenal to make the United States immune to surprise. But that loses any advantage that might accrue from smaller forces. Another approach is to provide greater warning of future dangers, both by having the best intelligence possible and by establishing transparency measures, either tacit or explicit, that will provide alerts to the United States. Also, if restarting warhead production is a concern, it is better to attack that problem directly, by keeping warhead production capability warm, rather than by keeping more warheads than are needed.

When contemplating nuclear force reductions, the United States must consider not only the reactions of potential enemies, but also those of allies. Allies may feel they need nuclear security guarantees from the United States and, if U.S. forces are reduced too far, those guarantees become suspect. Allies might respond in one of two ways that would be detrimental to U.S. security: they might start to develop their own nuclear capability or they might shift alliance to some other, presumably more useful, nuclear guarantor.

U.S. allies, Britain and France, have developed independent nuclear capabilities. Part of the motivation for Britain and France was political. France was probably more interested in appearing to maintain interests distinct from those of the United States while Britain wanted to continue to be counted among the post-World War II great powers.

⁵ Payne, p. 10.

Israel perhaps simply did not want to depend on U.S. guarantees for its security. Alternatively, the Israelis might have figured that the United States would rather use *its* nuclear weapons than let Israel use *theirs*, so their possession of nuclear weapons helped assure U.S. nuclear engagement. The effects of reduced U.S. arsenal size and capability are difficult to predict based on these cases because these countries developed nuclear weapons at a time when the United States had a large nuclear arsenal. Presumably the deficit was in perceived U.S. commitment, not in U.S. capability. Other allies of the United States during the Cold War, who clearly had the technical capability to develop nuclear weapons, for example, Japan, Taiwan, South Korea, and Germany, refrained. Even if incentives for nuclear proliferation among U.S. allies are much reduced because of the overall reduced threat and nuclear emphasis, that does not tell us how much it is reduced relative to potential countervailing increased incentives due to lower U.S. capability and commitment. Thus, the United States can reduce its arsenal to some extent while holding allied proliferation incentives constant, although exactly how much certainly has not been demonstrated in this paper.

The second danger, that allies might seek other nuclear guarantors, may be as conceptually complex but, in practice, is probably simple. Nuclear guarantees are highly theoretical but conventional military power is clearly palpable, thus, the huge predominance of U.S. conventional power almost certainly overwhelms the effects of reduced nuclear arsenal size if the United States keeps even a minimal nuclear force.

B. U. S. NUCLEAR FORCE STRUCTURE

This essay opened with an argument that the Cold War is not a useful baseline from which to gauge today's nuclear forces but that we will have to make do with Cold War weapons because replacing them is a low priority. Unfortunately, if we want to reduce nuclear weapons to weapons of absolutely last resort, basically restricting their use to deterrence of other nations' nuclear attack, then we probably would design them very differently from today's arsenal. It may be that we will simply never be able to get those old clothes to fit, so the essay ends with some speculation on force structure.

Damage-limiting counterforce attacks, especially at low force levels, are seductive but ultimately futile. What we gain by pursuing counterforce is uncertain, but the dangers resulting from pursuing counterforce is clear. The benefit of simply giving up on the mission is easier to see and can be captured. In particular, to be useful against

Russia, counterforce attacks have to be complete surprise attacks. U.S. policymakers have to decide that the United States would strike Russia when a crisis is not even advanced enough to cause them to disperse their forces.

Counterforce is what creates the need for promptness in our nuclear weapons. By eschewing counterforce and going to low force levels, new basing options open up to us. For example, without a prompt response requirement, the United States could bury missiles deep underground, making them immune to attack, thereby removing any incentive for an enemy to contemplate a first strike against us. Questions about launch on warning or launch under attack become moot.

If the United States wished to further emphasize that it had no intention of executing counterforce attacks in a new, conventionalized world, it could design weapons to make that impossible. Just as nuclear weapons cannot be un-invented, neither can missile guidance systems. But the United States could eliminate its fast fliers and ballistic missiles, making a surprise first strike virtually impossible, while retaining high confidence in the ability to retaliate against other targets. Air-breathing delivery systems might be deeply buried stealthy intercontinental cruise missiles, smaller than single warhead ballistic missiles.

The same effect could be achieved by retrofitting Trident submarines to carry stealthy cruise missiles. One problem with the SSBNs is that, while they are invulnerable at sea, they create very lucrative targets while in port. Typically half are in port, which has the double disadvantage of creating a target and requiring twice as many warheads as are actually deployed. But the SSBNs and the cruise missiles could be designed to be moved reliably in stout containers so as one boat came in, the missiles would be transferred to the next due to leave. In that way, never more than one boatload of cruise missiles would be in port at any time and the total inventory of weapons would not have to exceed requirements.

If tactical nuclear weapons were deemed useful for deterring WMD use by rogue states, then they should be short-range theater weapons that will not threaten Russian or Chinese central forces. If the United States wishes to maintain long-term reliability of its much reduced nuclear arsenal, it may need to develop uranium gun-assembled devices that require minimal maintenance. These could be developed while maintaining the Comprehensive Test Ban Treaty (CTBT) and the Nonproliferation Treaty (NPT), both of which promote the goal of de-emphasizing nuclear weapons.

C. AREAS OF ADDITIONAL STUDY

This essay has tried to lay out some general thoughts on the role of nuclear weapons a decade after the Cold War, with special attention to the *numbers* of weapons needed. The essay admittedly leaves many questions unanswered and raises more. Some of these unresolved questions could be productively addressed in more focused, follow-on work. These include:

- More careful, quantitative analysis of what is required for a “minimal” deterrent
- Detailed analysis of the upper limit on the number of nuclear weapons that might be used in a theater war, for example, Korea or Iraq
- The international political repercussions of “too few” nuclear weapons
- Military options for isolating rather than destroying deep targets and the consequences of not being able to destroy them
- The relationship between small missile defense forces and small nuclear arsenals
- New basing options that are available if the rapid response requirement is removed and new basing options that are affordable for small arsenals.

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